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(54) **Tibial element for a replacement knee prosthesis**

Schienbeinteil für Knieersatzprothese

Élément tibial pour une prothèse de remplacement du genou

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(73) Proprietor: **HOWMEDICA INTERNATIONAL INC.  
Shannon Co. Clare (IE)**

(72) Inventors:  
• **Lawes, Peter  
Kingsmead  
Berkshire (GB)**

• **Ashby, Alan Miles  
Berkshire SL6 4LD (GB)**

(74) Representative: **Bridge-Butler, Alan James et al  
G.F. Redfern & Co.  
Redfern House  
149/151 Tarring Road  
Worthing, West Sussex BN11 4HE (GB)**

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**FR-A- 2 674 123                      US-A- 4 936 853  
US-A- 4 938 769                      US-A- 4 944 757**

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## Description

This invention relates to a tibial element for a replacement knee prosthesis.

Tibial elements for replacement knee prostheses are known which are provided with one or more selectable alternative stems which can be selected by the surgeon to meet the requirements of the patient. In devices of this kind the selected stem is usually screw threaded into or onto the tibial tray and due to the stems themselves usually being relatively circularly symmetrical about a longitudinal axis their angular position relative to the tibial tray is immaterial. There are however advantages in being able to provide stems which are non-symmetrical but in order to do this it is necessary to be able to locate them in relation to the tibial tray so that the desired relative configuration is obtained and the present invention is intended to provide a construction to allow this.

United States Patent Specification No. 4 936 853 shows a modular knee prosthesis in which a selected stem is located into a tibial tray by means of a self-locking morse taper. A number of alternative modular stems are described which may be provided with flutes or have radially projecting flanges.

In constructions of the type set forth above the surgeon selects the appropriate stem for the patient concerned at the time of the operation and the stem is then assembled to the tray in the surgery.

Difficulties arise however during assembly due to the tendency for the stem to rotate in the tapered socket in the tray when the locking device, usually a pin or bolt, is tightened. It is often necessary for there to be accurate alignment between the cross-sectional shape of the stem and the configuration of the tray and this tends to be lost during tightening. This misalignment is particularly acute if the lower portion of the tray has a shaped engagement feature intended for engagement with the condylar area of the tibia of the user and the present invention is intended to overcome the disadvantage set out above.

According to the present invention a tibial element for a replacement knee prosthesis comprises a tibial tray provided with one or more bearing components, the lower portion of said tray having a shaped engagement feature intended for engagement with the proximal subcondylar area of the tibia of the user, and a stem which can be attached to said tray by a tapered spigot and socket construction characterised by alignment means for locating said stem in a predetermined angular position in the socket and in relation to said shaped engagement feature on the tray.

Thus, the alignment means can be arranged to act to prevent relative angular movement in the direction of rotation if means for drawing the spigot and socket connection together, in the form of a screw, are used.

In a predetermined construction the alignment means includes an abutment on said engagement fea-

ture which acts on a location portion provided on the stem.

In a preferred construction the shaped engagement feature comprises at least two projections which extend radially outwardly from the spigot and socket connection and these may be in the form of angled fins.

Two of said abutments can be provided, one on each of said projections, and a position spaced radially away from the spigot and socket connection.

The stem can be provided with a substantially radially outwardly projecting flange or flanges and thus two flanges can be aligned with said radially outwardly extending projections on the tray which carry said abutments.

Preferably the stem is of substantially cruciform cross-section to provide four radially extending wings.

The tapered spigot and socket connection can rely on applied end pressure to hold it in position, the alignment means acting to ensure that it is accurately located in a predetermined angular position but if desired means may be included for drawing the spigot and socket connection together and maintaining it in position, the alignment means acting to prevent any undesired angular rotation between the parts during tightening, or during the implanted life of the product if overload or fixation breakdown occurs.

A number of alternative stems can be provided with each tray so that there is a modular assembly.

The bearing surface or surfaces can be provided on a bearing component or components secured to the upper portion of the tray and these can be of the form set forth in the Applicants' co-pending European Patent Application No. 89307478.1 (Publication No. 0 353 921).

The lower surface of the tray is preferably provided with an ingrowth surface to allow bone to interlock therewith.

If desired openings can be provided in the tray to receive screws to secure the initial fixture of the tray into the bone stock.

The invention can be performed in many ways but one embodiment will now be described by way of example and with reference to the accompanying drawings in which :

Figure 1 is an exploded part-sectional side elevation of the components of a modular construction of a tibial element ready for assembly which does not embody the invention;

Figure 2 is a cross-sectional side elevation of a tibial tray embodying the invention taken on the line II-II of Figure 5 with sectioned web not shown;

Figure 3 is a plan view from beneath of the tibial tray shown in Figure 2 but to a smaller scale;

Figure 4 is a partial cross-sectional view on the line IV-IV of Figure 5 with the webs not sectioned but shown complete ;

Figure 5 is a plan view from above of the tibial tray 5 shown in Figure 2;

Figure 6 is a part-cross sectional view of a shaped stem for use in the invention;

Figure 7 is an end view in the direction of the arrow VII in Figure 6;

Figure 8 is an isometric view of the stem shown in Figures 6 and 7;

Figure 9 is a plan view from above of a bearing component for use with the invention;

Figure 10 is a cross-sectional view on the line X-X 20 of Figure 9;

Figure 11 is a plan view from beneath of the same component; and,

Figure 12 is a side elevation of a retaining screw for use with the invention.

The drawings show a modular construction for a tibial element for a replacement knee prosthesis according to the present invention which includes a tibial tray and a number of alternative stems. Figure 1 shows a tibial tray 1 which is a cast metallic construction, the lower surface of the tray is provided with an integrally cast ingrowth surface 2 which is more clearly shown in Figures 2, 3 and 4. This ingrowth surface can be of any known kind of ingrowth surface which can be either integrally cast or sintered, diffusion bonded or fabricated to it to allow the bone to interlock when the tray has been fitted. Alternatively, the surface could be roughened or textured to allow for a good keying with a bone cement.

The lower portion of the tray 1 is provided with a shaped engagement feature in the form of two fins 3 which extend outwardly from a central downwardly extending boss 4 and into the condylar area of the tibia when fitted and these fins allow for good torsional stability with minimal invasion of bone stock. On each fin there is a small recess 5 which provides an abutment adjacent the boss 4 the purpose of which will be described hereafter.

The boss 4 has a bore 6 the walls of which are tapered to provide a Morse taper and the upper end of the bore extends into the top surface of the tray by a cylindrical portion 7 the upper end of which is counter-bored to provide a projecting flange 8.

The tray is provided with three screw holes 9, 10, 11 which are most clearly shown in Figures 3 and 5. These screw holes allow for the placement of cortical or cancellous bone screws or alternatively bone screws which

connect to resorbable fasteners to allow the more secure initial fixation of the tray into the bone stock. When a cemented tray is to be used these screw holes will not be provided. The screw holes 9, 10, 11 are arranged in a configuration which is thought to have bio-mechanical advantages. The posterior screw hole 11 in the central intercondylar area allows for a cortical or cancellous screw to be placed into the posterior bone stock of the tibia. The two anterior screw holes 9 and 10 allow for the angulation of screws down into the cancellous bone stock or alternatively to the cortex in a number of possible areas laterally and posteriorly. These screws must be placed very carefully if they are placed into the anterior areas of the tibia due to the very thin skin coverage of the anterior cortex. As will be seen most clearly from Figures 1 and 2 the upper end 12 of these screw holes is spherical and the lower end 13 conical. This allows for some angulation chosen by the surgeon at the time of insertion of the screws and a typical screw is shown in Figure 12 the head 70 of which has a shallow part-spherical underside 71 to co-operate with the spherical shape of the upper end 12 of the holes. The upper surface 72 of the head 70 is of shallow part-conical form. This ensures that there is accurate conformity between the screw and its seat in all positions of angular operation, and the conical form of the top drive surface of the screw ensures the minimal clearance so that it does not foul with the plastic bearing component 30 when it is subsequently introduced into the tibial tray.

The particular combination of locations of screw holes and fins on the tray allow them to be used simultaneously since the screws avoid the other fixation elements.

It will be noted that none of the holes 9, 10, 11 are in a position which may induce stress intensities in the overlying bearing component 30. Such stresses must be avoided in areas of high load support, as for example in the centre of the tibial condyles.

The top surface of the tray is marked with compass lines 15 around the holes 9 and 10 which can be used by the surgeon when he pre-drills the bone for the insertion of the screws, allowing for more accurate placement. These are usable even when drilling is done free hand or when a directing instrument is used to more accurately locate the screws.

The overall shape of the tibial tray 1 is designed to match as closely as possible with a symmetric design the cross-sectional face of the tibial bone when it is resected.

The underside surface of the tray 1 incorporates a boundary wall structure 16 and a built up area 17 in the intercondylar posterior zone. The boundary wall 16 reinforces from a strength point of view the tibial tray. The solid area 17 in the posterior intercondylar area is to accommodate the posterior screw's passage through the hole 11 but also serves to reinforce the tray against fracture which in historical designs has occurred in this

area which is subjected to the most extreme loads when offset bending of the tibial tray occurs.

The upper part of the tibial tray 1 has a number of male features which serve the function of locating the snap fit bearing elements 30, to be described and also allows for the insertion of the fixing screw 60 for the modular stem 50 also to be described. Lugs 18 and 19 which are the medial and lateral extremes of the tray and an anterior lug 20 locate the bearing components 30. Each bearing component 30 is held into the tray by a lip capture 21 on the extreme lateral or medial lug and a snap fit hook retention 22 into the rim of an intercondylar eminence structure 23. The bearing components are in two halves, medial and lateral, a medial half 30 being shown in Figures 9, 10 and 11. This allows for different forms or heights of components to be used in the medial or lateral compartments, and also ties up to the construction of the lateral meniscal type tibial baseplate 1 as set forth in the Applicants' co-pending European Patent Application No. 91301613.5 (Publication No. 0 447 065). In this case the same fixed medial bearing elements are used in this total condylar design as are used in the lateral meniscal design.

The shape of the intercondylar eminence 23 is chosen to minimise incursion of this feature into the available bearing area of the bearing components so that the maximum thickness of the bearing material is available in the condylar area. Nevertheless, it is designed in such a way as to encompass the screw seating for the screw 60 for the modular stems 50 and so that at its posterior margin it encompasses the full width of the posterior cruciate cut out area in the tray. This again assists in reinforcing and strengthening this area since it is the site of historical fracturing of metal tibial trays. The posterior face 24 of the intercondylar eminence 23 is seen to be angled continuously at 30° in a conical form. This allows for the passage of the posterior cruciate ligament past this feature without the presence of sharp elements which could abraid against the soft tissue structure. This 30° cone surface is extended further onto the posterior surface of the intercondylar area of the bearing components 30 to match up on assembly, as is most clearly shown in Figure 9 and indicated by reference numeral 25.

Two similar but handed bearing components are used, a medial 30 and a lateral (not shown), or a left and a right component. These may be of varying heights and also of varying sectional or rotational forms as referred to above. The features on the under surface of each bearing component match the male features on the top of the baseplate 1. The elements are constructed in ultra high molecular weight polyethylene and a small catch 31 engages through the elasticity of the material with the lip 21 on the base plate, a further catch 32 is provided which engages beneath the hook retention 22.

The use of separate medial and lateral bearing components is however not essential and in an alternative construction a stabiliser type bearing component

which fits into the same trays as the separate medial and lateral components can be of one piece bearing construction. This engages the lip 21 on either the medial or lateral extreme of the tibial tray and then snap fits into the lip 31 on the opposite side of the component clearing all the male features by having appropriate cut outs in its undersurface.

As shown in Figure 1 the assembled tibial element comprises the tibial tray 1, bearing components 30 on its upper surface and a stem 50 which is drawn and locked into place by a fixing screw 60. Thus the element is assembled by inserting the stem into the bore 6 and locking it in place by the locking screw 60.

The tibial element is provided with a number of different modular stems for alternative use with the baseplate tray 1. The stem 50 shown in Figure 1 is of known type and does not embody the invention, it has a generally cylindrical form with grooves 51 for engagement either of cement or into bone tissue. This type of stem is provided in a number of different lengths and diameters so that they can be easily matched to the patients particular requirements. At the upper end of the stem there is a spigot 52 which has a male Morse taper with a female screw thread 53 running internally into it. In practice the stem male taper is introduced into the female taper in the bore 6 of the tibial baseplate 1 and the fixing screw 60 is inserted into the thread 53 in the stem to draw the male taper into engagement with the female taper and retain it rigidly in place. A Nylock pellet (not shown) is used to ensure that this screw 60 does not loosen subsequently after implantation. In addition, the snapping into place of the bearing components or component will also avoid the danger of this screw becoming disconnected and floating into the patient's joint. There is no provision with this stem for locating it in a predetermined angular position relative to the tray.

An alternative form of stem is shown in Figures 6, 7 and 8 which embodies the invention. This stem 62 comprises a spigot 55 of similar shape and configuration to the spigot 52 as shown in Figure 1 and is provided with substantially radially outwardly projecting flanges in the form of four fins 56, 57, 58 and 59. The fins 57 and 59 match and line up with the fins 3 on the base plate 1.

Each of the fins 57 and 59 have location portions provided by protruding extensions 61 which, when the stem is in position, co-operate with the recesses 5 in the wings 3 thus locating the stem in a predetermined angular position and aligning it with the base plate 1. The alignment means prevent relative angular movement between the parts when the screw 60 is tightened.

The cruciform stem provides excellent resistance to torsion and also to medial lateral and anterior posterior bending loads exerted on the tray 1. Nevertheless, the finned form of the stem means that very little bone stock needs to be removed from the tibia to accommodate it.

Moreover, when stems of this type are used with the base plate described above, of either the cylindrical or cruciform type, the use of screws is not precluded because of the particular geometry chosen. In this

respect, the screw shown in Figure 12, because of its spherical head form and very low profile, allows it to be located within the thickness of the metal tibial tray 1 and for the screws angulation through cones of up to 30° included angle as per the surgeon's choice at intervention.

It will be appreciated that there can be many alternative stem shapes which can be used with benefit provided they can be correctly aligned. The facility to use any one of a number of modular stems allows the surgeon to select the appropriate stem for the operation concerned.

When the product is delivered to the market place the bore 6 of the tray can be blocked by a tapered plastic plug. If modular stems are to be used with the tray this plug, which can be constructed from a number of different bio-compatible plastics, can be punched out from the socket and the appropriate stem is interconnected in its place.

#### Claims

1. A tibial element for a replacement knee prosthesis comprising a tibial tray (1) provided with one or more bearing components (30), the lower portion of said tray having a shaped engagement feature (3) intended for engagement with the proximal subcondylar area of the tibia of the user, and a stem (62) which can be attached to said tray by a tapered spigot and socket (6,55) construction characterised by alignment means (5,61) for locating said stem (62) in a predetermined angular position in the socket (6) and in relation to said shaped engagement feature (3) on the tray.
2. A tibial element as claimed in claim 1 characterised in that said alignment means include an abutment (5) on said engagement feature (3) which acts on a location portion (61) provided on said stem (62).
3. A tibial element as claimed in claim 1 or claim 2 characterised in that said shaped engagement feature comprises at least two projections (3) which extend radially outwardly from the spigot and socket connection (6,55).
4. A tibial element as claimed in claim 3 characterised in that said projections are in the form of angled fins (3).
5. A tibial element as claimed in claim 3 or claim 4 when dependent on claim 2 characterised in that two of said abutments (5) are provided, one on each of said projections (3), and at positions spaced radially away from the spigot and socket connection (6,55).
6. A tibial element as claimed in claims 1 to 5 characterised in that said stem (62) is provided with a sub-

stantially radially outwardly projecting flange or flanges (56, 57, 58, 59).

7. A tibial element as claimed in claim 6 characterised in that two of said flanges (57, 59) are aligned with said radially outwardly extending projections (3) on said tray which carry said abutments (5).
8. A tibial element as claimed in claim 6 or claim 7 characterised in that said stem (62) is of substantially cruciform cross-section to provide four radially extending wings (56, 57, 58, 59).
9. A tibial element as claimed in any one of the preceding claims characterised by including means (60) for drawing the spigot and socket connection (6, 55) together and maintaining it in position.
10. A tibial element as claimed in any one of the preceding claims characterised by including a number of alternative stems (62) to provide a modular assembly.
11. A tibial element as claimed in any one of the preceding claims characterised in that the lower surface of the tray (1) is provided with an ingrowth surface (2) to allow bone to interlock therewith.
12. A tibial element as claimed in any one of the preceding claims characterised by opening (9, 10, 11) in the tray (1) to receive screws (70 - 72) to secure the initial fixture of the tray (1) into the bone stock and to allow screws to be inserted into the posterior bone stock of the tibia and into the cancellous bone stock or to the cortex laterally and posteriorly.

#### Patentansprüche

1. Tibiales Element für eine Knieersatzprothese, umfassend eine mit einer oder mehr Lagerkomponenten (30) versehene tibiale Platte (1), wobei der Unterteil der besagten Platte ein für einen Eingriff mit dem proximalen subkondylären Bereich der Tibia des Benutzers vorgesehenes geformtes Eingriffsmerkmal (3) aufweist, sowie einen Schaft (62), der mittels einer konischen Zapfen- und Muffenkonstruktion (6, 55) an der besagten Platte befestigt werden kann, gekennzeichnet durch Ausrichteinrichtungen (5, 61) zum Positionieren des besagten Schaftes (62) in einer vorbestimmten Winkelposition in der Muffe (6) und in Bezug zu dem besagten geformten Eingriffsmerkmal (3) auf der Platte.
2. Tibiales Element nach Anspruch 1, dadurch gekennzeichnet, daß die besagten Ausrichteinrichtungen einen Anschlag (5) auf dem besagten Eingriffsmerkmal (3) einschließen, der auf einen auf den besagten Schaft (62) vorgesehenen Positionierteil (61) einwirkt.

3. Tibiales Element nach Anspruch 1 oder Anspruch 2, dadurch gekennzeichnet, daß das besagte geformte Eingriffsmerkmal mindestens zwei Vorsprünge (3) umfaßt, welche sich von der Zapfen- und Muffenverbindung (6, 55) aus radial nach außen erstrecken. 5
4. Tibiales Element nach Anspruch 3, dadurch gekennzeichnet, daß die besagten Vorsprünge in Form von im Winkel angeordneten Rippen (3) vorliegen. 10
5. Tibiales Element nach Anspruch 3 oder Anspruch 4, wenn rückbezogen auf Anspruch 2, dadurch gekennzeichnet, daß zwei der besagten Anschläge (5) vorgesehen sind, einer auf jedem der besagten Vorsprünge (3) und an Stellen, die in radialem Abstand weg von der Zapfen- und Muffenverbindung (6, 55) angeordnet sind. 15
6. Tibiales Element nach den Ansprüchen 1 bis 5, dadurch gekennzeichnet, daß der besagte Schaft (62) mit einem im wesentlichen radial nach außen überstehenden Flansch oder Flanschen (56, 57, 58, 59) versehen ist. 20
7. Tibiales Element nach Anspruch 6, dadurch gekennzeichnet, daß zwei der besagten Flansche (57, 59) mit den besagten radial nach außen verlaufenden Vorsprüngen (3) auf der besagten Platte ausgerichtet sind, welche die besagten Anschläge (5) tragen. 25
8. Tibiales Element nach Anspruch 6 oder Anspruch 7, dadurch gekennzeichnet, daß der besagte Schaft (62) von im wesentlichen kreuzförmigem Querschnitt ist, um vier radial verlaufende Flügel (56, 57, 58, 59) zu schaffen. 30
9. Tibiales Element nach einem beliebigen der vorangehenden Ansprüche, dadurch gekennzeichnet, daß es eine Einrichtung (60) einschließt, um die Zapfen- und Muffenverbindung (6, 55) zusammenzuziehen und sie in Position zu halten. 35
10. Tibiales Element nach einem beliebigen der vorangehenden Ansprüche, dadurch gekennzeichnet, daß es eine Reihe von alternativen Schäften (62) einschließt, um eine modulare Baugruppe bereitzustellen. 40
11. Tibiales Element nach einem beliebigen der vorangehenden Ansprüche, dadurch gekennzeichnet, daß die Unterseite der Platte (1) mit einer Einwachsfläche (2) versehen ist, um eine Verzahnung von Knochen damit zu ermöglichen. 45
12. Tibiales Element nach einem beliebigen der vorangehenden Ansprüche, gekennzeichnet durch Öff-

nungen (9, 10, 11) in der Platte (1) zur Aufnahme von Schrauben (70 - 72), um die anfängliche Fixation der Platte (1) in der Knochenunterlage zu sichern und es zu ermöglichen, Schrauben in die posteriore Knochenunterlage der Tibia und in die spongiöse Knochenunterlage oder lateral und posterior bis zur Cortex einzusetzen.

#### Revendications

1. Élément tibial pour une prothèse du genou comportant un plateau tibial (1) équipé d'un ou de plusieurs constituants d'appui (30), la partie inférieure dudit plateau présentant un élément d'engagement profilé (3) prévu pour un engagement avec la surface subcondylaire proximale du tibia de l'utilisateur, et une tige (62) qui peut être fixée audit plateau à l'aide d'une structure à pivot et manchon conique (6, 55), caractérisé par des moyens d'alignement (5, 61) pour positionner ladite tige (62) dans une position angulaire prédéterminée dans le manchon (6) et par rapport audit élément d'engagement profilé (3) sur le plateau. 15
2. Élément tibial selon la revendication 1, caractérisé en ce que lesdits moyens d'alignement comprennent une butée (5) sur ledit élément d'engagement (3) qui agit sur une partie de positionnement (61) prévue sur ladite tige (62). 20
3. Élément tibial selon la revendication 1 ou la revendication 2, caractérisé en, ce que ledit élément d'engagement profilé comporte au moins deux parties saillantes (3) s'étendant radialement vers l'extérieur depuis la liaison à pivot et manchon (6, 55). 25
4. Élément tibial selon la revendication 3, caractérisé en ce que lesdites parties saillantes sont sous la forme d'ailettes obliques (3). 30
5. Élément tibial selon la revendication 3 ou la revendication 4, lorsque rattachées à la revendication 2, caractérisé en ce que deux desdites butées (5) sont prévues, l'une sur chacune des parties saillantes (3), et en des positions radialement espacées de la liaison à pivot et manchon (6, 55). 35
6. Élément tibial selon l'une quelconque des revendications 1 à 5, caractérisé en ce que ladite tige (62) est munie d'un ou de plusieurs flasques (56, 57, 58, 59) faisant saillie sensiblement radialement vers l'extérieur. 40
7. Élément tibial selon la revendication 6, caractérisé en ce que deux desdits flasques (57, 59) sont alignés avec lesdites parties saillantes (3) s'étendant radialement vers l'extérieur sur ledit plateau qui portent lesdites butées (5). 45

8. Elément tibial selon la revendication 6 ou la revendication 7, caractérisé en ce que ladite tige (62) est sensiblement cruciforme en coupe pour constituer quatre ailes s'étendant radialement (56, 57, 58, 59). 5
9. Elément tibial selon l'une quelconque des revendications précédentes, caractérisé en ce qu'il comprend des moyens (60) pour rapprocher la liaison à pivot et manchon (6, 55) et la maintenir en position. 10
10. Elément tibial selon l'une quelconque des revendications précédentes, caractérisé en ce qu'il comprend une pluralité de tiges différentes (62) pour constituer un ensemble modulaire. 15
11. Elément tibial selon l'une quelconque des revendications précédentes, caractérisé en ce que la surface inférieure du plateau (1) est munie d'une surface présentant des excroissances (2) afin de permettre à l'os de s'emboîter avec elle. 20
12. Elément tibial selon l'une quelconque des revendications précédentes, caractérisé par une ouverture (9, 10, 11) dans le plateau (1) pour recevoir des vis (70 72) pour fixer l'appareillage initial du plateau (1) dans la matière osseuse et pour permettre l'introduction de vis dans la matière osseuse postérieure du tibia et dans la matière osseuse de remplacement ou au cortex latéralement et postérieurement. 25

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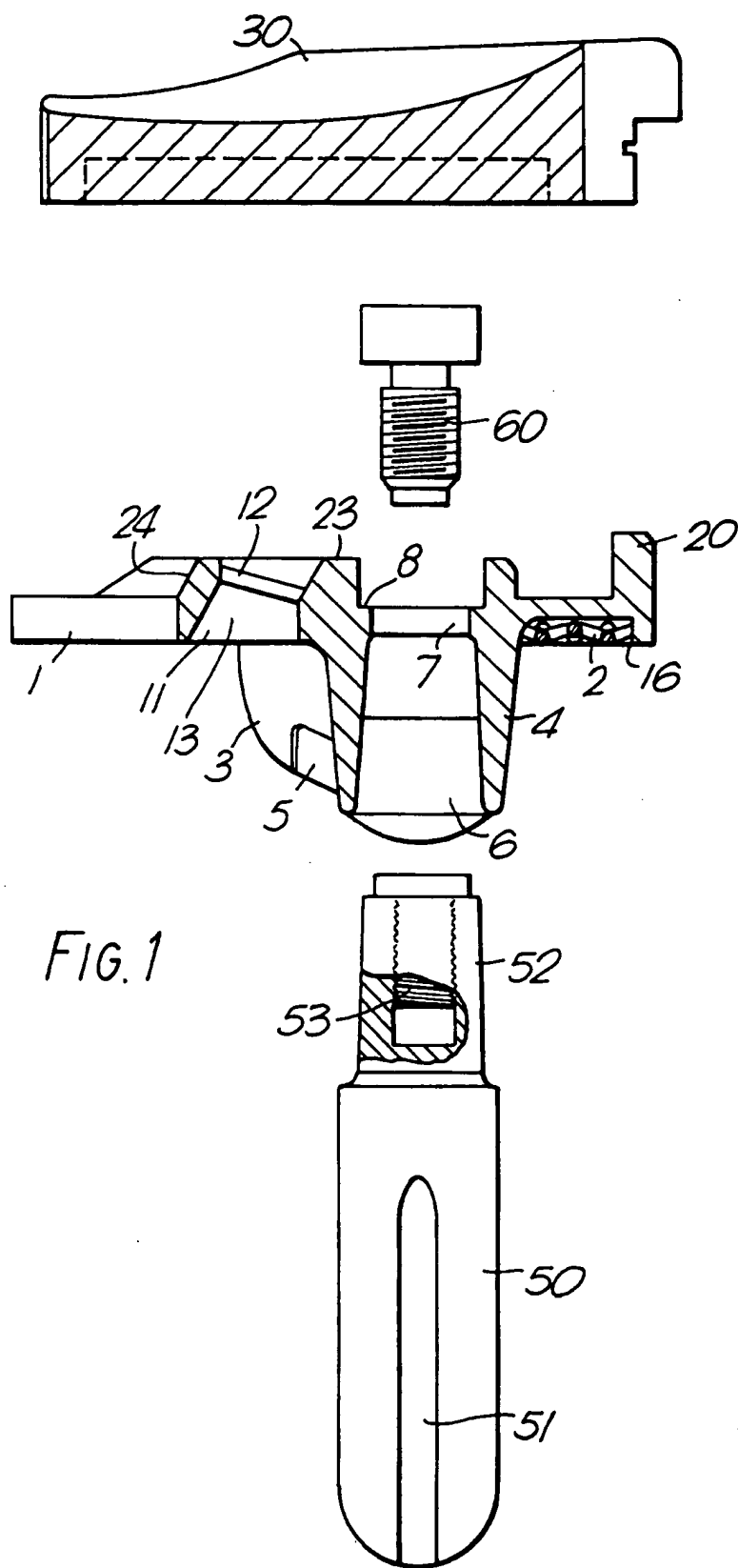
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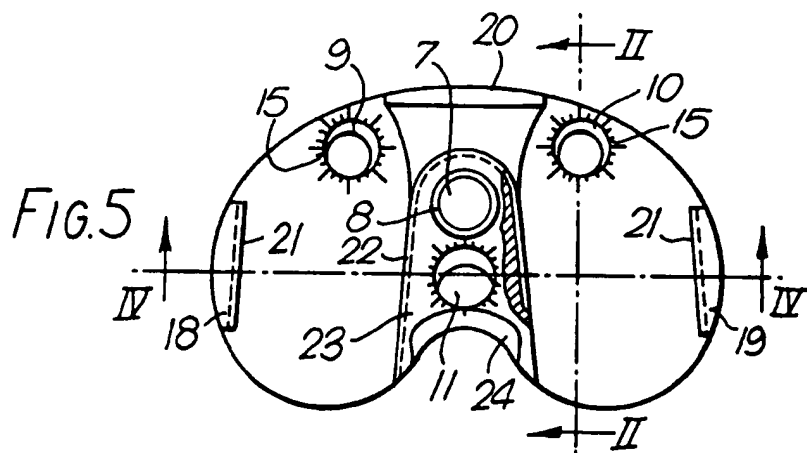
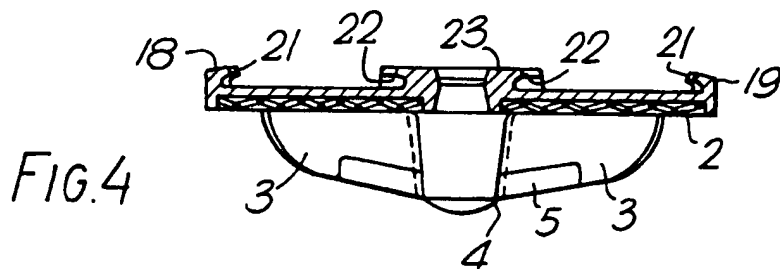
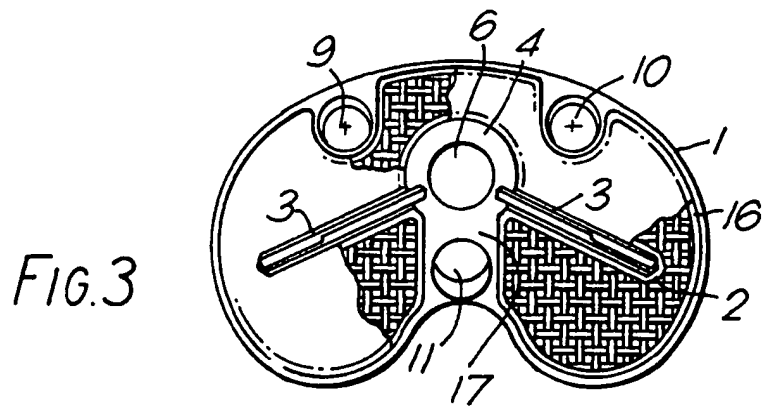
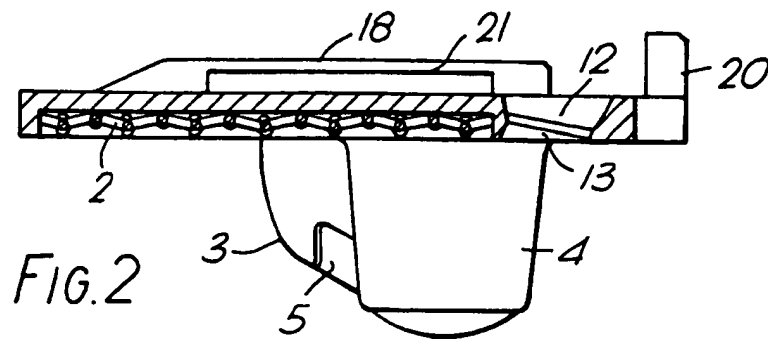
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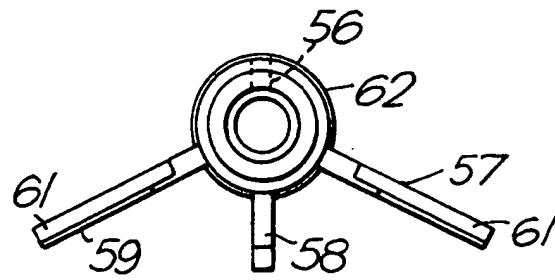
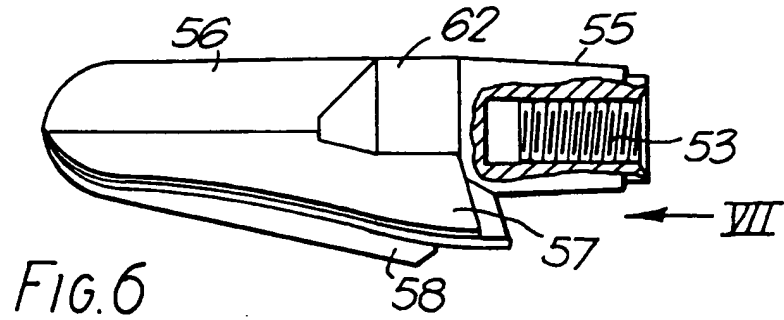


FIG. 7

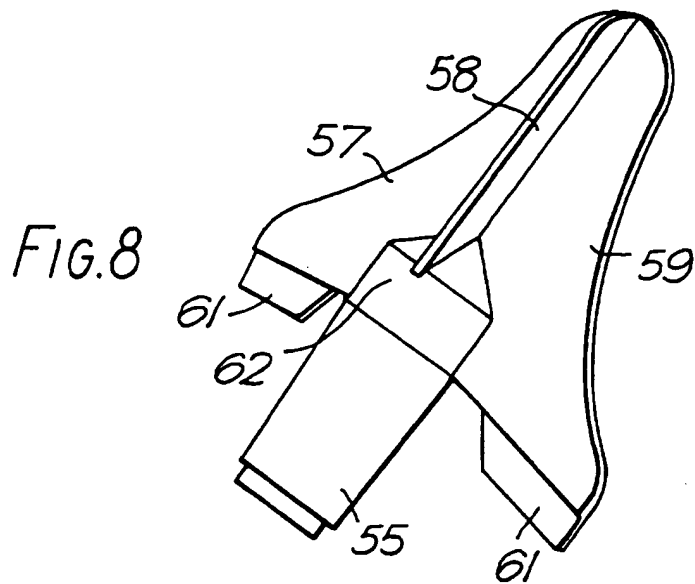


FIG. 8

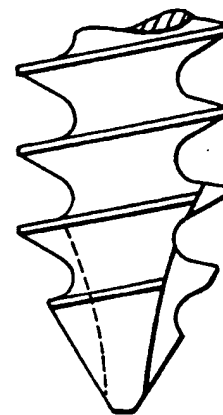
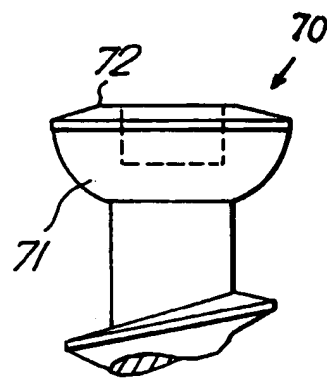
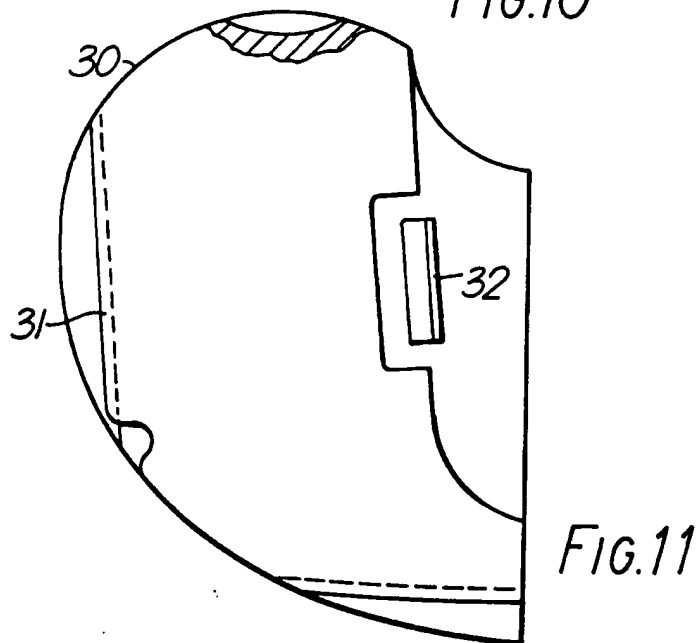
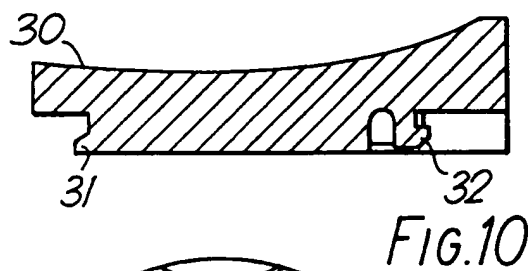
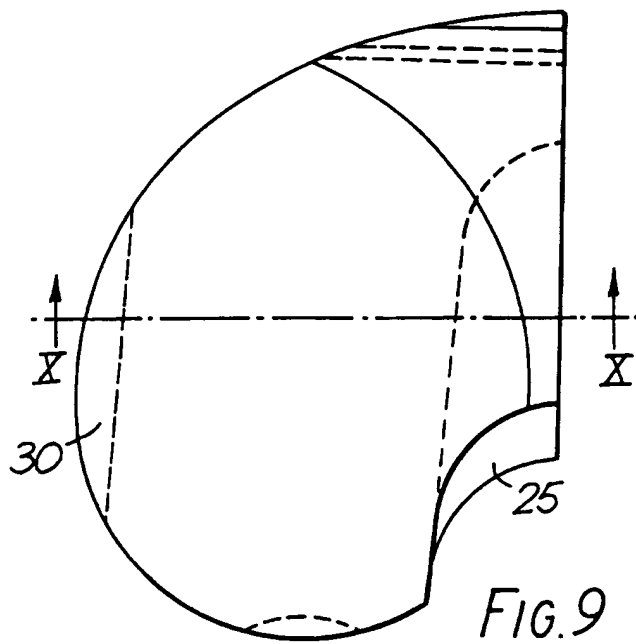


FIG. 12